Wilmette Public Schools, District 39 Science Curriculum, Grade 8

Cross-Cutting Concept: Evidence and Explanation

Guiding Questions	Scientific and Engineering Practices	CONNECTED/21st Century Learning
What is the nature of scientific inquiry? How do scientists go about their work? How do theories become accepted or refuted? What is the relationship of scientific claims to evidence? What is technology and how does technological development shape our world? How is technology created? How are technological problems defined and researched? How can a problem be stated so that it can be solved? How have others solved similar problems? What are technological systems and how can they best be modeled and improved? How can drawings be used to show the way things fit together? How can creative solutions be developed, clearly expressed, and evaluated? How can the best possible solution be developed to solve a technological problem? Why are controls needed?	Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS2-5) Science is an imaginative endeavor that is subject to modification as new information challenges current theories. It involves the collection of data, the use of logical reasoning, argumentation and the devising of hypotheses and explanations informed by evidence. Scientific inquiry is a dynamic process that is not limited to one scientific method. Inquiry engages learners in asking scientifically oriented questions, gathering and prioritizing evidence, formulating explanations, making connections to scientific knowledge and communicating and justifying explanations. Inquiry leads to new questions. Scientists keep honest/unbiased, clear and accurate records, value hypotheses and understand that more than one explanation can be given for the same evidence. value the role of computation and estimation in their work. use a variety of tools to inform their observations. organize information using tables, graphs, diagrams and symbols. question claims based on vague attributions and are skeptical of arguments based on small data samples. embrace unexpected results. All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ESS3-4) The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-ESS3-2),(MS-ESS3-3) Technology is a class of designed systems, products, or processes. The designed world is constantly changing as new technologies, tools, and materials are developed. Anyone can modify a technology, invent a new application of technology or make a new product (e.g. invent a new toy or paper airplane) by thinking about what they want to do, gathering the right knowledge and skills, and trying different ways of working until they succeed. The first step to solving technological problems is to define the problem in terms of criteria and constraints or limits. It is important to find out how others have solved similar problems and to learn more about the nature of the problem itself. Systems analysis and modeling are key tools in designing, troubleshooting and maintaining technological systems. The more clearly a technological problem is stated in this way the easier it is to design and compare possible solutions. Working together and expressing ideas in words, sketches, and models are helpful in coming up with different solutions to technological problems. After developing several solutions, the best solution can be chosen by comparing each of the solutions with the criteria and constraints developed to define the problem to see which meets them best. Solutions to design problems need to be tested and redesigned several times to arrive at the best available solution. Many products have built in components with feedback control systems (e.g. airbag in car triggered by collision).	Characteristics of Successful Learners- Persistence, Creativity, Problem Solving Teaching/Learning Styles and Learning Environment - Small Group Collaborative Work Claims and Evidence Site visits to collect data Technology - SMART Board Microscopes Data Analysis solar cars, solar panel data collection Communication/Collaboration - student designed work, small groups Learning Process - hands-on learning, inquiry Global Perspectives - use and production of energy world-wide Social Responsibility - Investigating alternative energy sources Ethical issues Environmental awareness Responding to real world problems

Unit: Energy Transfer — Time Frame: 12-13 weeks

Essential Questions: How does energy drive systems on Earth? How are human needs for energy changing and being met though the environment? How do we analyze the environmental and economic implications associated with the various methods of obtaining, managing, and using energy resources?
How can we support our claims with supporting evidence gathered through scientific investigation, modeling, and technological design?

CROSSCUTTING CONCEPTS:

Scale, Proportion, and Quantity
- Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.

Systems and System Models
- Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems.

Energy and Matter
- Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).
- The transfer of energy can be tracked as energy flows through a designed or natural system.

Patterns
- Graphs, charts, and images can be used to identify patterns in data.

Cause and Effect
- Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.
- Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Stability and Change
- Stability might be disturbed either by sudden events or gradual changes that accumulate over time.

Content Vocabulary: energy, tradeoffs, energy transfer, energy transformation, gravitational potential energy, kinetic energy, potential energy, friction, thermal energy, heat, temperature, generator, electromagnetism, chemical energy, elastic energy, electrical energy, light, sound, nuclear energy, conduction, insulation, Calorie, calorie, calorimeter, endothermic, exothermic, hydroelectric, fossil fuels, non-renewable resource, solar energy, wind energy, turbine, electrochemical, photovoltaic, circuit, passive solar heating
Academic Vocabulary: claim, evidence, explain, analyze, justify, variable, efficiency, control, alternative, effectiveness

Guiding Questions
- What are the advantages and disadvantages of different ways of meeting our energy needs?
- What are the different types of energy?
- How does energy transfer and transform?
- What does it mean for energy to be conserved?
- What are the relationships between forces and energy?
- How can we use natural resources to create energy?
- How do humans depend on earth's materials? How do they change the earth?
- How are humans' energy needs impacting the global climate?
- How can I contribute as a citizen scientist?

Teaching Resources & Technology
LabAids SEPUP Energy

Next Generation Science Standards Performance Expectations	Disciplinary Core Ideas	Science & Engineering Practices, Skills, & Knowledge
ESS3.D MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. **ESS3.A** MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. **ESS3.C** **ESS3-4.**	**ESS3.A: Natural Resources** ● Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. **ESS3.C: Human Impacts on Earth Systems** ● Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.	**Scientific & Engineering Practices** ● Plan and carry out investigations ● Construct explanations and design solutions ● Construct a scientific explanation based on evidence ● Analyze and interpret data ● Apply scientific principles to design ● Construct an argument supported by evidence

Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. **PS2.B** MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. **PS3.A** MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. **PS3.B** MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. **PS3-4.** Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. **PS3.C** **PS3-2.** Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.	• Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. **ESS3.D: Global Climate Change** • Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. **PS2.B: Types of Interactions** • Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. **PS3.A: Definitions of Energy** • Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. • A system of objects may also contain stored (potential) energy, depending on their relative positions. • Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. **PS3.B: Conservation of Energy and Energy Transfer** • When the motion energy of an object changes, there is inevitably some other change in energy at the same time. • The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. • Energy is spontaneously transferred out of hotter regions or objects and into colder ones. **PS3.C: Relationship Between Energy and Forces** • When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object	• Ask questions to clarify evidence • Construct and interpret graphical displays of data • Develop models • Construct, use, and present arguments to support a claim **<u>Formative Understandings</u>** • Identify commonly used energy resources • Identify lesser used (alternative) energy resources • Compare the availability, cost of producing & distributing, impact on environment, technology needed of various energy resources • Evaluate advantages and disadvantages of alternative energy resources • Represent research findings in visual presentation, charts, graphs, diagrams • Organize research (materials, resources, tools, cost-effectiveness, safety) • Analyze the transfer of energy within and between systems • Identify renewable and nonrenewable energy resources

Unit: Genetics — Time Frame: 9-10 weeks

<u>Essential Questions:</u> How are characteristics of one generation of organisms passed to the next?
What are the consequences regarding inheritance and variation across generations?
How can we support our explanations "claims" with supporting evidence gathered through modeling and scientific investigation?

CROSSCUTTING CONCEPTS:

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural systems.
- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Structure and Function

- Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function.

Patterns

- Patterns can be used to identify cause and effect relationships.
- Graphs, charts, and images can be used to identify patterns in data.

S*ystems and System Models*

- Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.

CONTENT VOCABULARY: chromosome, sexual, inherited trait, recessive, clone, meiosis, asexual, Punnett Square, dominant, homozygous, alleles, offspring, genetic testing, DNA, heterozygous, mutation, heredity, genes, trait, GMO, protein, natural selection, artificial selection, phenotype, genotype
ACADEMIC VOCABULARY: Claim, evidence, explain, analyze, justify, compare, contrast, variation,

GUIDING QUESTIONS:

How are the inherited traits distributed to offspring?
How do offspring vary from their parents and siblings?
How do variations occur as inherited characteristics are passed to offspring?
How do genetic and environmental factors play a role in the growth and development of an organism?
How does genetic information of organisms change over time?
Why is understanding mutations and genetics disorders important?
How can I contribute as a citizen scientist?

TEACHING RESOURCES:
LabAids Life Science: Genetics

Next Generation Science Standards Performance Expectations	Disciplinary Core Ideas	Science & Engineering Practices, Skills, & Knowledge
LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. **LS3-1** Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. **LS3-2** Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.	**LS1.B: Growth and Development of Organisms** LS1.B: An organism's growth is affected by both genetics and environmental factors ● Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. *(secondary to MS-LS3-2)* ● Animals engage in characteristic behaviors that increase the odds of reproduction. (MS-LS1-4) ● Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (MS-LS1-4) ● Genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5) **LS3.A: Inheritance of Traits** LS3.A: *Inheritance of traits*- Genes chiefly regulate a specific protein, which affect an individual's traits ● Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1) ● Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2) **LS3.B: Variation of Traits** LS3.B: *Variation of Traits* - in sexual reproduction, each parent contributes half of the genes...genetic information can be altered because of mutations, which may result in beneficial, negative, or no change to proteins in or traits of an organism ● In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2) ● In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1) **LS4.B: Natural Selection (artificial selection)** LS4.B: *Natural selection* - both natural and artificial selection result from certain traits giving some individuals an advantage in surviving and reproducing, leading to predominance of certain traits in a population ● Natural selection leads to the predominance of certain traits in a population, and the suppression of	**Scientific & Engineering Practices** Develop and use models Construct explanations and design solutions Obtain, evaluate, and communicate information Engage in argument from evidence Use mathematics and computational thinking Construct a scientific explanation based on evidence Develop and use a model Analyze and interpret data for patterns Apply scientific ideas to construct an explanation Analyze displays of pictorial data to compare patterns Gather and synthesize information **Formative Understandings** Compare and contrast meiosis and mitosis. (Venn or T Chart) Diagram meiosis and mitosis Explain how genetic material is inherited Explain how genetic material is transferred and combined Describe how genetic material is unique Explain how variations and mutations occur Create a Punnett Square Analyze a Punnett Square Explain why DNA is referred to as the blueprint

	others. (MS-LS4-4) ● In *artificial* selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring. (MS-LS4-5) ● Organisms have structures and functions that facilitate their life processes, growth, and reproduction. ● Organisms have mechanisms and processes for passing traits and variations of traits from one generation to the next.	***Formative Assessments*** *Create a cost/benefit analysis (social cost, social benefit; personal cost, personal benefit) that would be used for making a decision of genetic testing or cloning.*

Unit: Water Study and Invasive Species **Time Frame: 13-14 weeks**

Essential Question: How can we determine the health of an aquatic ecosystem? *How can we support our explanations "claims" with supporting evidence gathered through scientific investigation and technological design?*

CROSSCUTTING CONCEPTS:

Patterns

● Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

Cause and effect

● Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

Scale, proportion, and quantity

● In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

Systems and system models

● Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

Energy and matter

● Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

Structure and function

● The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

Stability and change

● For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Content Vocabulary: coagulation, flocculation, watershed, contaminants, stream quality, ecosystem, distillation, phosphates, nitrates, dissolved oxygen, pH, solubility, abiotic factor, biotic factor, invasive species, macroinvertebrate, biodiversity, indicator species, purification

Academic Vocabulary: Claim, evidence, explain, analyze, justify, factors, predictions

GUIDED QUESTIONS:

- How do we get drinking water?
- How do biotic and abiotic factors influence an aquatic ecosystem?
- Why is it important to understand how humans are changing watersheds?
- How can biodiversity be used to understand of the health of aquatic ecosystem?
- What stream chemistry principles are used to analyze an aquatic ecosystem?
- How do different organisms interact and depend on their ecosystem?
- How can humans restore the health of an aquatic ecosystem?

TEACHING RESOURCES & TECHNOLOGY:

LabAids SEPUP Water
NSTA Invasive Species
NSTA Watershed

Next Generation Science Standards Performance Expectations	Disciplinary Core Ideas	Science & Engineering Practices, Skills, & Knowledge
ESS2.C MS-ESS2-4: Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of	**ESS2.C: The Roles of Water in Earth's Surface Processes** Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.	**SCIENCE & ENGINEERING PRACTICES:** Asking questions (for science) and defining problems (for engineering) Developing and using models

gravity. **ESS3.C** MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. MS-ESS3-4: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. **LS2.A** MS-LS2-1: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. MS-LS2-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. MS-LS4-4: Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. MS-LS4-6: Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. **LS2.C** **LS4.D** **ETS1.B** MS-LS2-5: Evaluate competing design solutions for maintaining biodiversity and ecosystem services.	Global movements of water and its changes in form are propelled by sunlight and gravity. **ESS3.A: Natural Resources** Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. **ESS3.C: Human Impacts on Earth Systems** Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. **LS2.A: Interdependent Relationships in Ecosystems** Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1) In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1) Growth of organisms and population increases are limited by access to resources. (MS-LS2-1) Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, & mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living & nonliving, are shared. (MS-LS2-2) **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. **LS4.D: Biodiversity and Humans** Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. **ETS1.B: Developing Possible Solutions** There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.	Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations (for science) and designing solutions (for engineering) Engaging in argument from evidence Obtaining, evaluating, and communicating information **SKILLS & KNOWLEDGE** Assess stream health, support claim with evidence after reviewing multiple layers of data requiring analysis and inferences regarding patterns and trends. Identify factors that influence stream health. Conduct water quality test Represent water quality data Identify indicator species Conduct chemical tests to assess abiotic factors Explain the significance of biodiversity when analyzing the health of an ecosystem Explain how storm water is treated